Reviews and Views:

INSECT CONSERVATION AND DIVERSITY

M. RAGAEI*
M. ALLAM**

SUMMARY: This paper discusses insect diversity, the scientific interest and potential value of insects, insect conservation, measurements of insect diversity and future of insect diversity in Egypt.

Combining the approaches of systematics and community ecology that improve our understanding of insect diversity are also discussed. For those interested in the traditional systematic approach it will provide identified specimens, identification guides, and natural history data. On the other hand our results will provide needed data on insect communities, on methods of estimating species richness and community ecology and ecosystem function. Above all, it showed agreement in the conservation's tool box, allowing the largest component of biodiversity, the arthropods including insects; to be used for the conservation of habitats.

Key Words: Insect diversity, insect conservation, community ecology.

INTRODUCTION

The earth's genes, species and ecosystems are the product of hundreds of millions of years of evolution, and have enabled our species to prosper. But the available evidence indicates that human activities are leading to the loss of the plant's biological diversity (or biodiversity). With the projected growth in both human population and economic activity, the rate of loss of biodiversity is far more likely to increase than stabilize.

No one knows the number of species on earth, even to the nearest order of magnitude. Estimates vary from 5 to 80 million species or more, but the figure is most probably in the range of 30 million. Only about 1.4 million of these living species have been briefly described. Of these, about 750.000 are insects, 41.000 are vertebrates and 250.000 are plants. The remainder consists of a complex array of invertebrates, fungi, algae and other micro-organisms.

Insecta is one of the five classes in the subphylum Uniramia. The Uniramia comprises those arthropods which have mandibles and pair of antennae, and other appendages which are primitively unbranched. The other four classes in the subphylum are collectively known as the myriapoda. 'Uniramia' occur worldwide

*From National Research Center, Pests and Plant Protection Department, Dokki, Cairo, Egypt.
**From Egyptian Environmental Affairs Agency EEAA.

and are predominantly terrestrial, but many of them live in freshwater and a few are marine representatives.

The success of insects is attributed largely to the evolution of flight, which has improved dispersal, escape from predators, and access to food and optimal environmental conditions. Insects feed on every imaginable source of plants, the blood and tissues of invertebrate and vertebrate animals, fungi, protozoa, yeasts and bacteria, and the processed or decomposing dead remains of plants and animals, including timber, books, humans, leather, bones, keratin, corpses and excreta (1-4).

The beetle *Niptus holofeucus* can survive on cayennae pepper or sal ammoniac and the fly *psilopa petrolel* inhabits pools of crude petroleum.

Scientific Interest and Potential Value

The substantial benefits to mankind from insects generally receive less publicity than the economic losses that result from their roles as vectors of diseases (3) and as pests of agriculture, fibers and stored goods. The main benefits are ecological, economic, scientific and aesthetic (5).

Because of their vast numbers and variety, insects are dominant components of many food webs in both the production and decomposition divisions of ecosystems. The biomass of insects in most freely - draining soils for exceeds that of the more evident birds and mammals above the surface. Because insects are small in size, yet so diverse and ecologically important.

Since environmental quality has become of major concern, terrestrial and particularly aquatic insects have therefore been utilized as valuable indicators of ecological conditions (6).

Conspicious insects such as butterflies and dragenflies are particularly useful in monitoring changes.

In both ecological and economic terms, insects are useful in pollinators. Many wild plants depend upon insects, and those plants are part of a genetic pool which may be of known or as yet undiscovered values. Bees are the major importance and are vital for the reproduction of many crops (7,8).

Scientifically and aesthetically, insects make a substantial contribution in terms of their fascination, their beautiful or bizarre appearance, their improvements to man's environment, their usefulness in teaching and in biogeographical, (9,10), environmental (6), synecological and autecological investigations. Economic returns indirectly accrue from the essential basic research on genetics, evolutionary biology and medicine in which *Drosophila* and various lepidoptera are often used as biological tools.

In this concern, it is difficult to cover fully the wide range of man's interest in insects. It is evident that their impact is considerable, and that the known or potential value stored in their diversity should be preserved for the future.

The causes of the decline and extinction of insects may be broadly divided into two categories, natural threats and man - induced threats. Natural changes in the populations of insect species, the evolution of new species and the extinction of unsuccessful species through natural selection.

Man - induced changes are currently by far the most important factors affecting insects world-wide. They operate on time-scale drastically foreshortened from the ponderous natural changes over geological time. Through technological innovation, man is able to create or destroy landscapes and biotopes within a geological instant, permitting no opportunity for natural selection of adaptable genotypes. Man - induced changes that affect insects are here divided into five categories: 1) changes to land, 2) changes to water, 3) atmospheric pollution, 4) changes to closely associated fauna and flora 5) specific threats to pre-species.

Conservation

Concern for declining insect population has been voiced since the first half of the 19th century and the historical aspects of insect conservation have been reviewed elsewhere (11,5). The present momentum began in the 1960's, legislative measures were taken in the 1970's and being strengthened in the 1980's and 1990's.

1-Legislation

International agreement is combined in the Convention on International Trade in Endangered Species of World Fauna and Flora (CITES), which controls and monitors import and export of listed species. Appendix I, which contains no insects, is a list of species in which trade is subject to strict regulation, and is virtually prohibited except to fulfil scientific needs. Appendix II lists species in which trade is regulated or monitored.

All north European countries give greater emphasis to protecting habitats and biotopes than to passing legislation concerning, individual species. Nevertheless, in many cases individual species are protected by law, often where they may not be adequately protected within reserve areas or where a threat from trade or over-collecting is perceived.

In Britain, the governmental Nature Conservancy Council notifies landowners of sites of Special Scientific Interest (SSSIs) that they may own, and requires to be consulted about all proposed developments in these sites. Some SSSIs have been selected on entomological grounds and an increasing number have been established at National Nature Reserves (NNRs). Entomological information is used in selecting NNRs, which have an important role in preserving the habitat of many insect species.

For example, 32 out of the 37 British species of dragonfiles breed in NNRs, and the other reserves protect significant populations of rare butterflies such as the Swallowtail (*Papilio machaon*), the Black Hairstreak (*Strymonidia pruni*) and the Chequered Skipper (*Carterocephalus palaemon*). Other important insect localities are protected in the reserves of voluntary bodies such as the National Trust, the many Country Trusts which support the Royal Society for Nature Conservation, and the Royal Society for the Protection of Birds (12). Several other north European countries, including Belgium (13), West Germany (14, 15), France (16,17), Switzerland (18) and Poland (19,20), give legislative protection to named insects, and all European countries protect habitats in national reserves. Legislation to conserve insects is generally absent in southern Europe and the Mediterranean region, although Spain has published its own Lepidoptera Red Data Book (21) and conservationists there (22) and in Italy (23), are pressing for legislation. In many other areas of the world legislation relating to insects is confined to bans on collecting or trade of one or a few species (e.g. Brazil), or a ban on all collecting (e.g. parts of Australia) (24,11), Mexico and recently Kenya. Exceptional legislation has been passed in Papua New Guinea, protecting their seven rarest species of birdwing butterflies and providing for prevention of collecting and trade, and for habitat preservation and management. At the same time butterfly farming has become a significant local industry, as it has been for some time in Taiwan (25). In P.N.G. two unprotected birdwings, *Ornithoptera priamus* and *Troides oblongomaculatus*, and a huge saturniid moth, *Coscinocera hercules*; contribute most of the income (26).

The 1973, U.S. Endangered Species Act requires the Secretary of the Interior to protect endangered species through the Office of Endangered Species in the Fish and Wildlife Service. Many individual states in the U.S.A. have passed their own local legislation to protect insects or their habitats (11,26,27).

Research and management, recording and mapping, lists of threatened insects, International Union for Conservation of Nature IUCN which began the first services of red data books in 1966, and continue with further volumes on insects.

In Egypt, we need to establish an insect zoo. It will serve in conservation of life of insects, teaching research, rearing parasites and predators of some insect pests.... etc.

The future: By far the greatest threat to insects is destruction of their natural habitat, and many countries are taking strong measures to gazette reserves and national parks. However, national parks and reserves must be adequately protected and must not be eroded by financial interests, even during times of recession. Elements remote from reserves but essential to their integrity must also be preserved, particularly watersheds. Insects can be of value in choosing sites for reserves; in South America data on the density, distribution and biogeography of insects are proving to be valuable in this regard (9,10). The needs of insects do not always comply with those of vertebrates and it is not safe to assume that protection of large areas for vertebrates will automatically safeguard the insect diversity. Because of their small size and relatively modest needs, insects are able to occupy ecological niches which are more numerous and far smaller in all dimensions (space, time etc.) than those of vertebrates. For this reason impact assessments may operate on too large a scale, and harmful effects may be overlooked. In most cases there is no substitute for surveys specifically to assess the insects that need to be considered. The important insects surveys being carried out in Egypt and Arab countries should themselves be extended, and the same approach should be used in tropical centres throughout the world. To strengthen the case for habitat protection it is essential to document further the contents of tropical biomes, to list and describe the species and to investigate their ecological requirements. Both intensive and extensive surveys are needed in order to identify the conservation requirements of insects in those habitats where they are most abundant, using new or existing local taxonomic and ecological centres wherever possible. These aims are fully endorsed by the World Conservation Strategy, which emphasizes the need to protect living resources for ecological reasons, for their genetic diversity and for sustainable utilization (17).

How to measure insect diversity

Biologists refer to global number of species as the 'grail number', the quest for which will greatly improve our understanding of diversity patterns on earth. To begin the quest, we face the first and largest challenge. Species are not pennies. A machine can be designed to count 30 million pennies, but counting 30 million species is different. The world is filled with individual organisms that are distributed in various ways into an unknown number of species. The second challenge is that species are not equally abundant. Abundance of species are spatially and temporally variable. Some species are very abundant, some are very rare, and the rest are in between.

Systematics and community ecology

Taxonomy and systematics are terms used for all or various combinations of the following activities:

1. Describing and naming new species;
2. Assembling morphology, behavior, natural history and geographical range data associated with species names.
3. Constructing classification schemes which allow identification of species.
4. Estimating phylogenetic relationships of species.

In the 'use it or lose it' theory or biodiversity conservation, the perceived value of biodiversity will be greater if it is known and accessible to humanity. Taxonomy and systematics are the basic tools for this approach.

Community ecology is the study of patterns in assemblages of species (28). Community ecologists examine commonness and rareness of species, relationships between species diversity and community stability (29), contributions of habitat variable to species diversity (30,31), and relative abundance of species in different sizes (31,32).

Museum - based taxonomists systematics have the ability to identify enormous numbers of species using the 'get them all' approach, through efficient means of collecting, preparing, identifying and cataloguing species.

The Design

The general design is to (a) use 'Get them all' methods to produce complete species lists for selected 'Focal Taxa' (b); use quantitative methods to obtain community samples for much larger 'survey Taxa' and (c) use the 'Focal Taxa' results to calibrate or evaluate the quantiative procedures and estimates (33).

Focal Taxan results can be used for a direct estimate of Survey Taxon richness. Assuming that Focal Taxon species and the views remaining Survey Taxon species have equal probabilities of capture in the quantitative samples, then estimate the Survey Taxon richness by:

$$\frac{Q\ (\text{Focal})}{S\ (\text{Focal})} = \frac{Q\ (\text{Survey})}{S\ (\text{Survey})}$$

where Q = number of species in the quantitative samples and S = total number of species in the community. Both terms are known for the Focal Taxon. Q is known for the Survey Taxon, allowing S (survey) to be calculated.

In effect $Q_{(focal)}$ / $S_{(focal)}$ is a measure of the efficiency of the quantitative samples. Ten replicates of this measure give some ideas of the variance between taxa.

CONCLUSIONS

Insects and their relatives can be found in many places in most habitat areas: pond, desert, mangrove, rain forest and house. In these and other habitats, insects dominate the animal inventory. In both ecological and economic terms insects are useful as pollinators. Scientifically and aesthetically, insects are useful specially in genetics, evolutionary biology and medicine in which *Drosophila* and various Lepidoptera are often used as biological tools. The need to establish insect zoo in Egypt.

By combining the approaches of systematics and community ecology, will improve our understanding of insects diversity. For those interested in the traditional systematics approach, it will provide identified specimens, identification guides, and natural history data. For those interested in community ecology and ecosystem function, it will provide needed data on insect communities, and on methods of estimating species richness. Above all, it should augment the conservationists toolbox, allowing the largest component of biodiversity (34), the insects, to be used for the conservation of tropical habitats.

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Correspondence:
M. Ragaei
National Research Centre,
Pests and Plant Protection Department,
Dokki, Cairo,
EGYPT.